CRATER SIZE-FREQUENCY DISTRIBUTIONS AT THE NORTH RAY AND SOUTH RAY CRATERS.

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Introduction: The calibration of the ages of young craters for the lunar chronology is important for determining model ages of younger units on the Moon and other terrestrial bodies across the Solar System. Data from the Lunar Reconnaissance Orbiter Camera (LROC) is being used to revise and improve the lunar cratering chronology calibration points for the Apollo landing sites [e.g.,1-3]. Here, we investigate areas around the two young craters, North Ray and South Ray at the Apollo 16 landing site, and compare our results with previous work.

North Ray and South Ray Craters: North Ray crater is ~950 m in diameter and located 4.2 km north of the Apollo 16 landing site. Samples 67015 and 67016 from Station 11 near North Ray crater have exposure ages ~50 Ma [4,5]. It is one of the important calibration points of the lunar chronology [6,7].

South Ray crater is located 6 km southwest of the landing site and has a diameter of 700 m. It is one of the youngest craters (~2 Ma [8]) on the Moon from which we have samples.

Methods: LRO Narrow Angle Camera (NAC) images were processed with the Integrated Software for Imagers and Spectrometers (ISIS) [9] and imported into ArcGIS. The different count areas and measurements were created using CraterTools in ArcMap [10]. We defined the areas around the craters using albedo and morphological contrast, Clementine spectral data, and a NAC digital terrain model. Next, we measured the crater size-frequency distributions (CSFDs) around the two craters (*Fig. 1)*. We excluded noticable secondary craters, and randomness analysis [11] was used to identify and exclude crater clustering. The CSFDs were plotted with Craterstats 2.0 in cumulative and relative forms [12,13] using the production function of [7] to derive absolute model ages (AMAs) (*Fig. 2*).

Results: The new areas around North Ray crater (*Fig. 1a*, areas 1-4) give an $N(1)$ value of 4.26×10^{-5} km^{-2}, and the area for South Ray (*Fig. 1b)* yields an $N(1) = 8.95\times10^{-7}$ km^{-2}. Applying the production function and chronology function of [7], our newly determined ages are 50.8 ± 2.5 Ma and 1.07 ± 0.26 Ma, respectively.

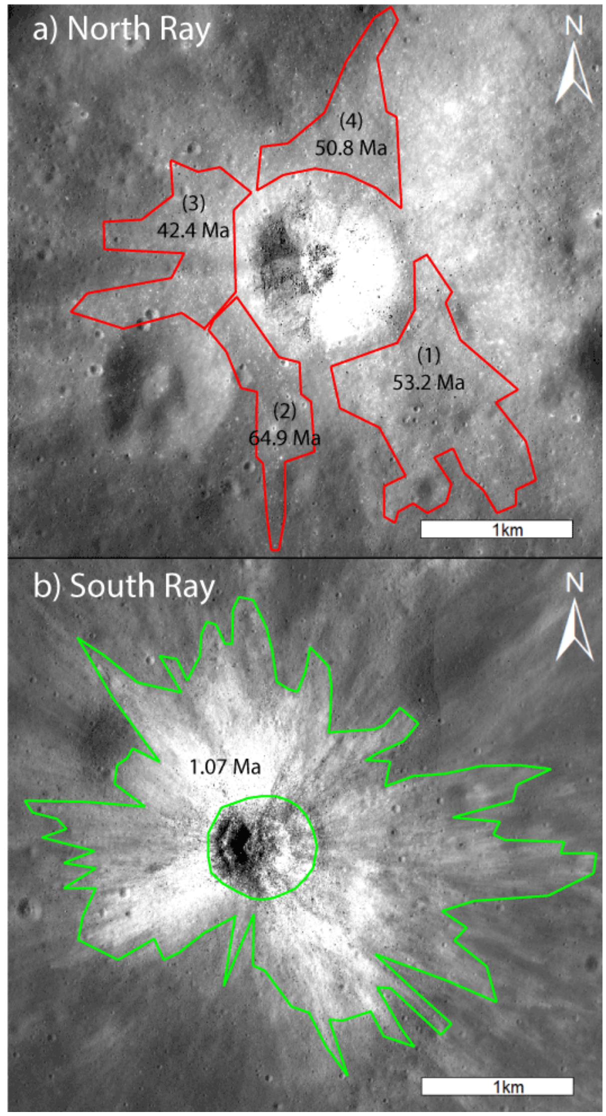

Figure 1. *Count areas around the North Ray (a) and South Ray (b) craters near the Apollo 16 landing site. (a) The red boundaries mark the four new count areas for North Ray crater and show the newly determined AMAs (black numbers). (b) The green boundary marks the new counting area on the rays of South Ray crater. The results of the North Ray crater counts on NAC images are similar and correspond with previous results from [1,6,14]. The AMA of South Ray is younger than previous results [15,16].*

Table 1. *N(1)s and AMAs of the North Ray and South Ray craters near the Apollo 16 landing site. The fifth line represents the combined four areas around North Ray crater.*

Unit	*N(1) (km^{-2})*	*AMA (Ma)*
North Ray		
1	4.46×10^{-5}	53.2±4.2
2	5.44×10^{-5}	64.9±7.2
3	3.55×10^{-5}	42.4±4.6
4	4.04×10^{-5}	48.2±5.2
1-4 merged	*4.26×10^{-5}*	*50.8±2.5*
South Ray	*8.95×10^{-7}*	*1.07±0.26*

Discussion: Previously determined *N*(1) values for North Ray crater include: *N*(1) = 4.4×10^{-5} km^{-2} [6], 3.90×10^{-5} km^{-2} and 3.84×10^{-5} km^{-2} [14], as well as 6.01×10^{-5} km^{-2} [1]. These values correspond to ages of 50.3 ± 0.8 Ma [15], 50.0 ± 1.4 Ma [6] and AMAs of 45.8 ± 3.7 and 46.5 ± 3.7 Ma [14]. Prior work also estimated ages for South Ray crater to be 2.04 ± 0.08 Ma [15] or 2.00 ± 0.2 Ma [16].

The results (*Table 1*) for the *N*(1) and AMA values are within the error of [6,14,15] for North Ray crater. The values for South Ray crater give younger AMAs compared to [15,16]. This could be due to adjusted count area and differences in the used images or because of slight differences in the measurement of the few craters available around South Ray. In order to improve our results, further CSFD measurements and fitting will be done.

Outlook: We are in the process of correlating the collected CSFD data with Apollo 16 sample ages related to the craters. This work is part of the ongoing reinvestigation of the Apollo 16 landing site [17].

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Figure 2. *CSFD measurements of the updated area(s) representative of North Ray (red) and South Ray (green) craters counted on LROC NAC data shown in a cumulative plot and fit with absolute model ages. Shown above is the randomness analysis of the NAC count area and, below, the relative crater frequency plot.*